# Climate Simulation Acceleration

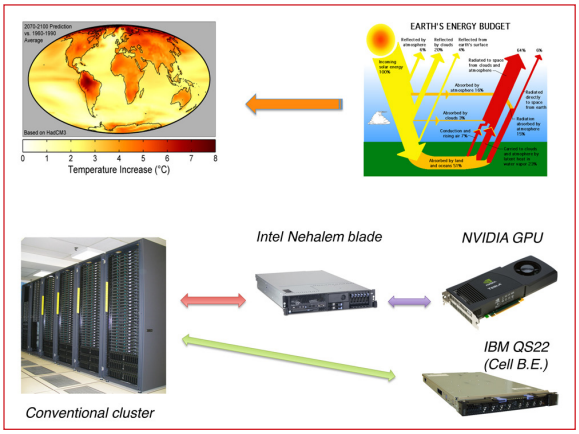
## Science Mission Directorate

High-resolution climate models have opened up a new area for global climate change and simulation research, and are becoming valuable tools for improving forecasting of hurricane tracks and other aspects of hazardous weather. Accelerator technology is playing an active role in heterogeneous computing technology and research advances.

Currently, climate simulations pose a serious challenge for computing platforms based on conventional multi-core processors, in terms of simulation duration and scalability. Accelerator technologies like the IBM Cell Broadband Engine (Cell BE) and NVIDIA graphics processing units (GPUs) provide an opportunity for managing this challenge. However, their programming models are closely related to the underlying architectures and differ significantly from existing ones such as Message Passing Interface (MPI) and OpenMP.

When adapting real-world applications such as climate simulations to accelerators, the challenges due to these differences are greatly amplified. Our work focuses on answering the following questions. What is the ratio of performance gain to costs, both human and system? How can the accelerated codes survive in next-generation accelerators?

In this project, representative climate codes have been ported to prototypes of hybrid computing systems (Intel processors connected to the IBM Cell BE or NVIDIA GPUs) to address such questions. The answers will help determine how to incorporate these accelerator technologies in computing platforms to effectively, efficiently, and economically shorten computing time for high-resolution climate simulations.

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An illustration of accelerated climate simulations. Climate change is closely related to the Earth's "energy budget," including all gains of incoming energy and all losses of outgoing energy. A climate simulation can speed up by offloading the compute-intensive model components from a conventional computer cluster to accelerators such as the Cell Broadband Engine (Cell BE) or NVIDIA graphics processing units (GPUs). *Shujia Zhou, NASA/Goddard*